



UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

[Signature]

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/676,645	10/01/2003	Gyung-Su Cho	OPP-GZ-2007-0009-US-00	7874
36872	7590	10/15/2007	EXAMINER	
THE LAW OFFICES OF ANDREW D. FORTNEY, PH.D., P.C. 401 W FALLBROOK AVE STE 204 FRESNO, CA 93711-5835			NADAV, ORI	
		ART UNIT	PAPER NUMBER	
		2811		
		MAIL DATE	DELIVERY MODE	
		10/15/2007	PAPER	

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)
	10/676,645	CHO, GYUNG-SU
	Examiner Ori Nadav	Art Unit 2811

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) Responsive to communication(s) filed on 04 September 2007.
- 2a) This action is FINAL. 2b) This action is non-final.
- 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) Claim(s) 1,4,5,8,22-24,27-32 and 34-37 is/are pending in the application.
 - 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) Claim(s) _____ is/are allowed.
- 6) Claim(s) 1,4,5,8,22-24,27-32 and 34-37 is/are rejected.
- 7) Claim(s) _____ is/are objected to.
- 8) Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) The specification is objected to by the Examiner.
- 10) The drawing(s) filed on _____ is/are: a) accepted or b) objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) All b) Some * c) None of:
 1. Certified copies of the priority documents have been received.
 2. Certified copies of the priority documents have been received in Application No. _____.
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) Notice of References Cited (PTO-892)
- 2) Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____.
- 4) Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) Notice of Informal Patent Application
- 6) Other: _____.

DETAILED ACTION***Claim Rejections - 35 USC § 112***

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1, 4-5, 8, 22-24, 27-32 and 34-37 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The claimed limitation of a "metal line consisting essentially of copper", as recited in claim 1, is unclear as to whether the metal line is formed of only copper (since using the term "consisting" does not provide for the inclusion of additional elements) or of a copper alloy (since the phrase "essentially of copper" means the inclusion of additional elements).

The claimed limitation of an "alloy layer consists essentially of copper and a low melting point metal", as recited in claim 1, is unclear as to whether the alloy layer includes only copper and a low melting point metal (since using the term "consisting" does not provide for the inclusion of additional elements) or of additional elements (since the phrase "essentially of copper and a low melting point metal" means the inclusion of additional elements).

The claimed limitations of "an alloy layer on an upper surface of the metal line having a top surface that is coplanar with or lower than a top surface of the insulation layer and vertical side surfaces that contact the barrier metal layer within the via", as recited in claim 1, are unclear how the phrase "and vertical side surfaces that contact

the barrier metal layer within the via", relates to the previous phrase. It is also unclear whether the element "vertical side surfaces that contact the barrier metal layer within the via" is the same element as "vertical side surfaces that contact the barrier metal layer" which was recited previously, or a different element.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claims 1, 4-5, 23-24, 27-32 and 34-37, as best understood, are rejected under 35 U.S.C. 102(e) as being anticipated by Matsubara (6,890,852).

Matsubara teaches in figure 1 and related text a semiconductor device comprising:

- a via within an insulation layer 16 over a semiconductor substrate 1;
- a barrier metal layer 6 on a surface of the via;
- a metal line 9 consisting essentially of copper in the via over the barrier metal layer having vertical side surfaces that contact the barrier metal layer; and
- a pad 13 in a predetermined region of the metal line; and

an alloy layer 10 (column 10, lines 20-22) on an upper surface of the metal line having a top surface that is coplanar with or lower than a top surface of the insulation layer and vertical side surfaces that contact the barrier metal layer within the via, wherein the alloy layer consists essentially of copper and a low melting point metal selected from the group consisting of aluminum, lead, and silver, wherein

the thickness of the alloy layer is less than a thickness of the metal line, wherein a protection layer 26 (see figure 12) comprising silicon nitride or silicon oxynitride on the metal line except for the predetermined region, wherein

the barrier metal comprises a metal selected from the group consisting of Ti, Ta, TiN, and TaN, and having a thickness between 200 and 800A

an insulation layer 101 comprises oxide over the semiconductor device, wherein the via is within the insulation layer, wherein

the barrier metal layer prevents the diffusion of copper from the metal line into the substrate, wherein

the alloy layer is completely within the via and exposed through an opening in the protection layer, wherein

the barrier metal layer covers all surfaces of the via and contacts the substrate, and

wherein a thickness of the alloy layer being less than a thickness of the metal line.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 8 and 22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Matsubara in view of Liu et al. (6,638,867).

Regarding claims 5 and 22, Matsubara teaches in figure 1 and related text substantially the entire claimed structure, as applied to claim 1 above, except a width of the pad is less than a width of via.

Liu et al. teach in figure 2 and related text a width of the pad 24 is less than a width of via.

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to use a width of the pad being less than a width of via in Matsubara's device in order to reduce the size of the device.

Response to Arguments

Applicant argues that Matsubara does not teach an alloy layer comprises copper and a low melting point metal selected from the group consisting of aluminum, lead, and silver.

Matsubara clearly teaches in column 10, lines 20-22 an alloy layer comprises copper and a low melting point metal selected from the group consisting of aluminum, lead, and silver.

Applicant argues that Matsubara does not teach a metal line consisting essentially of copper in the via over the barrier metal layer having vertical side surfaces that contact the barrier metal layer.

Matsubara teaches a metal line 9 consisting essentially of copper in the via over the barrier metal layer having vertical side surfaces that making electrical contact with the barrier metal layer 6.

Applicant argues that bump electrode 13 of Matsubara is not a pad.

It is well known in the art that a bump is used to bond two elements together and thus is synonymous to a bonding pad.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ori Nadav whose telephone number is 571-272-1660. The examiner can normally be reached between the hours of 7 AM to 4 PM (Eastern Standard Time) Monday through Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Lynne Gurley can be reached on 571-272-4670. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should

you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



O.N.
10/9/07

ORI NADAV
PRIMARY EXAMINER
TECHNOLOGY CENTER 2800